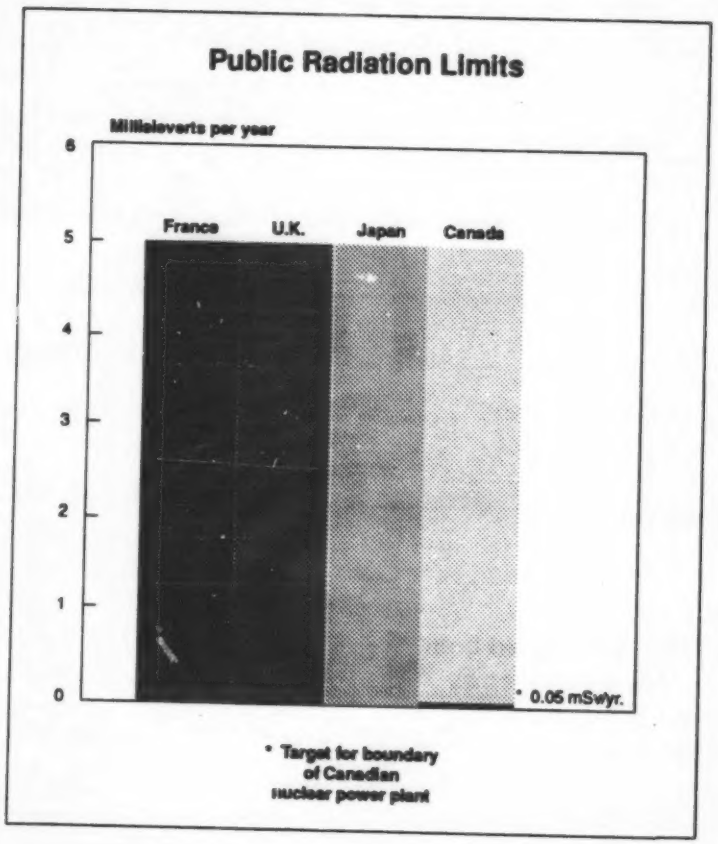
Canada's Radiation Scandal?



Are Canada's Radiation Limits Among the Worst in the Developed World?

Atomic Energy Control Board
Commission de contrôle de l'énergie atomique

Canada

91-01704/

Canada's Radiation Scandal?

INFO - 0362

Additional copies may be requested from
the address below. This document may
be reproduced in whole or in part
without special permission.

Atomic Energy Control Board
Office of Public Information
P.O. Box 1046
Ottawa, Ontario, Canada
K1P 5S9
tel: (613) 995-5894
fax: (613) 992-2915

Canada's Radiation Scandal?

Table of Contents

1. Introduction 1

2. Three New Reports 2

3. Other Studies 5

4. Health Dangers 5

5. The AECB's Radiation Standards – a Public Disgrace? 7

6. Conclusions 8

Annex – Canada's Radiation Limits 8

AECB Post Script 10

Comment on Cover Bar Chart 11

December 1990

1. Introduction

In July 1990, Greenpeace distributed a 16-page treatise entitled "Canada's Radiation Scandal" to a wide audience including the news media and, according to a covering letter, "academics, health practitioners and concerned citizens". The bottom line of the Greenpeace critique was that "Canada's radiation limits are among the worst in the developed world".

Whether or not you were one of the recipients of that significantly flawed publication, you might be interested to read this commentary on it from the Atomic Energy Control Board (AECB), the body that sets and enforces radiation standards covering the use of nuclear energy in Canadian industry, science and medicine.

Space, and your patience as a reader limit our coverage of Greenpeace's untrue, misleading and distorted points to the more significant ones. But to make it easy to follow, this commentary sticks as closely as possible to the original's content sequence, with one exception - the Executive Summary is not dealt with at all, because it is less of a summary than a polemic. We therefore begin with Greenpeace's first section, "Introduction":

Greenpeace: *Radiation is rarely discussed in Canada. In contrast it is hotly debated in medical and scientific circles in the US, the UK, and the USSR.*

AECB: Nonsense. There has been and will continue to be a great deal of discussion about radiation in Canada, in medical, scientific and other circles. Anyone interested need only ask a member of the Canadian Radiation Protection Association, the Canadian College of Physicists in Medicine, the Canadian Association of Physicists, the Canadian Association of Medical Radiation Technologists, or the Canadian Association of Nuclear Medicine. The AECB itself has sponsored conferences, seminars and workshops dealing with ionizing radiation, particularly its health and genetic effects, and funds a good deal of research on the subject each year. Over the past 15 years, literally from coast to coast, a number of commissions of enquiry have dealt publicly and at length with radiation in connection with uranium mining and nuclear reactor safety.

Greenpeace: *If this situation ("worst radiation standards in the developed world") is allowed to continue, in the future, Canada could experience an epidemic of radiation-induced cancers both in the public and among workers exposed to radiation.*

AECB: Ludicrous. The current whole-body dose limits have been in effect for three decades and no "epidemic" of radiation-induced cancers has resulted. At the low level of exposure actually experienced by both the public and workers, you can calculate that a few cancers may be caused, but they are not evident. Indeed, systematic follow-up of radiation workers at the Chalk River Nuclear Laboratories and Ontario Hydro nuclear facilities, as well as in similar establishments in the U.K. and the U.S.A., have provided no evidence of the calamitous health situation envisaged by Greenpeace, in fact quite the opposite. Furthermore, a recently

completed study by the U.S. National Cancer Institute found no increased risk of death from cancer for people living in 107 U.S. counties containing or close to 62 nuclear facilities.

2. Three New Reports

Greenpeace: *Recently, three authoritative reports have revolutionised the world's thinking on radiation; the upshot is that radiation is eight times more dangerous than previously believed.*

AECB: An inaccuracy wrapped in an exaggeration. Greenpeace refers to two completed reports and a draft one (see below), all of which discuss the risk of exposure to radiation in non-revolutionary fashion. One of the completed reports presents puzzling information which bears further investigation, and hence is not conclusive evidence of the hazards of radiation. Regarding the other two, the "upshot" is that radiation doesn't do anything to us now that it didn't do before, but the scientific estimation of the risk of exposure to it has been adjusted - by a factor of about three, not eight.

Beir V Report

(The fifth report of the U.S. National Academy of Science Committee on the Biological Effects of Ionizing Radiation, issued in 1989, is known as the BEIR V Report.)

Greenpeace: *The (BEIR V) report ... confirmed earlier predictions that there was no safe level of radiation.*

AECB: False. Given the severe limitations on studying enormous human populations, and other confounding factors, there is no possible way that the existence of a safe level of radiation can be either proved or disproved, and BEIR V does not attempt this. In the practice of radiation protection it is *assumed* that there is no absolutely safe level, but to establish this as fact (confirm a prediction) you would have to show, for instance, that everyday background radiation to which humans have always been exposed was negatively affecting people's health. No reputable study has ever found that this is the case.

Greenpeace: *In particular, the report estimated that the lifetime risk of fatal cancers due to radiation had increased to 8% per Sievert (a measure of radiation equal to 100 rem in old radiation units). This represents an eightfold increase in the 1977 risk estimate of 1% per Sievert (Sv) used to establish the current limits for exposure to radiation.*

AECB: Inaccurate, (and possibly quite confusing to readers.) A Sievert is a unit used to measure radiation dose, and a risk of "1% per Sievert" can be expressed in one of two ways: an individual who received a dose of 1 Sv (a high dose) would have one chance in a hundred of falling victim to cancer; or, if a hundred people each received 1/100th of a Sievert, one of them might contract the disease. The BEIR V Committee, using the widely accepted data from the

Japanese bomb survivors, calculated cancer risk figures for high dose and high dose rate - large doses received in a short time period - coming up with a maximum of 8% per Sievert. It then called for an adjusting factor to be applied for occupational and public exposures, since these are typically *low* dose and *low* dose rate. The number the Committee picked was 2, though it could have been less conservative and gone as high as 10. If you apply the adjustment factor of 2 to the 8% figure, you get 4%; and if you divide this by the previous risk value of 1.25% (it was rounded off by Greenpeace to 1%), the result is about 3 – that is, the BEIR V report estimates that the risk of exposure to radiation is about three times what was previously estimated, not eight times as Greenpeace would have you believe. To illustrate that these numbers are not particularly precise, it should be noted that BEIR V observes that because of the uncertainties involved, it is possible that the risk for low dose rates could even be *zero*.

ICRP Draft Recommendations

Greenpeace: *On February 16 1990, the International Commission On Radiological Protection (ICRP), whose limits are recognised by many governments, issued a lengthy draft report which also found that total radiation risk had increased from its 1977 estimate of 1% to 7.5% per Sievert.*

AECB: Not accurate. The ICRP does not set limits, it makes recommendations that national authorities often adopt in their radiation protection regimes. In any case, the increase in risk endorsed by the ICRP works out to about 3, not the 7.5 Greenpeace comes up with.

Greenpeace: *(The ICRP) proposed that its occupational limit, which Canada has observed in the past, be reduced from 50 milliSieverts (mSv) a year to an average of 20 mSv per year.*

AECB: Incomplete. The 50 mSv figure has in fact been retained by the ICRP as an absolute annual limit, but a further time-dependent limitation has been recommended for occupational exposure, which by nature tends to be recurrent: 100 mSv in a five year period, which would be achieved with a 20 mSv yearly average.

Gardner Report

Greenpeace: *On February 17 1990, the authoritative British Medical Journal published the most explosive of the studies; this pointed to the conclusion that radiation workers exposed to as little as 10 mSv (1 rem) in the 6 months before they conceived* (sic) *were 6 to 8 times more likely to father leukemic children than if they had received no radiation exposure at work. Canada's legal limit for workers is more than 3 times this amount.*

AECB: Misleading. Professor Martin Gardner's statistical study on leukemia associated with the Sellafield nuclear facility in the U.K. discovered an apparent association between workplace radiation dose and the increased likelihood of fathering a leukemic child. This is puzzling as it has not been found elsewhere, and runs counter to current knowledge of the genetic effects of radiation. Further work is being undertaken to determine whether the factor of radiation dose

is truly a cause or, as a common denominator, is simply an indicator of something else that might increase the risk of childhood leukemia. The jury is not yet in on this, and accordingly it is misleading to present Gardner's findings in the context of dose limits.

Greenpeace: *In Canada, the (Gardner) study received little attention until Greenpeace sent copies to all the major media outlets. The Federal health authorities responsible for protecting the public and workers from radiation dangers were initially ignorant of these developments.*

AECB: False. The AECB was well aware of this study at an early stage; it had a copy of Gardner's paper faxed from the U.K. a few days after it was published. A similar Canadian study, reviewed and supported by Dr. Gardner, is underway, and the more detailed analysis on Gardner's subjects in the U.K. is being closely followed. Since Greenpeace sets such store by the Gardner study, a responsible person might ask why the organization sent copies to the news media and not to the federal health authorities it chides (mistakenly) for being unaware of the work.

Greenpeace: *... from (Gardner's) figures, it can be calculated ... that radiation's genetic dangers to one's children may well be twice as serious as the new higher risk of cancer to oneself.*

AECB: Unscientific nonsense. Greenpeace makes an amateur's fundamental mistake of jumping to a conclusion by extrapolation from one set of very limited figures. The error is then compounded by contrasting everyone's personal risk from radiation with Gardner's unproven genetic association amongst a handful of nuclear workers' children, in an obvious appeal to our natural concern for children's welfare. The entire argument ignores the vast body of knowledge of the genetic effects of radiation on humans.

Greenpeace: *Perhaps the most important point of all is that Canada's official watchdog, the AECB, has not publicly addressed itself to any of these points and has not indicated any intention of doing so in the near future.*

AECB: Unreasonable. The "points" are essentially Greenpeace creations: the first is the one addressed immediately above; the second takes that false conclusion and creates another referring to the revised ICRP risk estimates; and the third folds both of these into gratuitous comments on the undermining of the "ability to reproduce", and the likelihood of women avoiding radiation workers as mates.

3. Other Studies

Greenpeace: *It should be noted that the above risk estimates (BEIR and ICRP) are very conservative. Greenpeace and other environmental groups have criticised these radiation authorities in the past for their conservative views ...*

AECB: Puzzling. Greenpeace and others have always criticized radiation authorities for being too lax or liberal, not too conservative! It is true, however, that the risk estimates in question are conservative. They are calculated using a type of "worst case" scenario and therefore represent the high end of a range of possible values – the prudent or conservative thing to do. Obviously Greenpeace is confused.

Greenpeace: *Independent researchers and scientists ... using more realistic assumptions have come up with much greater risk estimates.*

AECB: Misleading. A few maverick scientists have come up with exaggerated risk estimate figures using extreme values, but they do not represent the international consensus. The work of the person specifically named by Greenpeace has been overwhelmingly rejected by other scientists.

4. Health Dangers

Occupational

Greenpeace: *The Gardner and ICRP reports indicate that radiation workers exposed to 10 mSv and more are putting themselves and their future children at serious risk.*

AECB: Not true. As explained above, the Gardner findings bear further scrutiny and it is therefore misleading to connect them with dose limits at present. As for the ICRP, in its most recent recommendations there is no reference at all to "serious risk" at the 10 mSv level. Indeed, the international body considers a lifetime occupational exposure of up to 1 Sv (100 times the Greenpeace figure) to be tolerable, and bases its recommended dose limits on this value. Even now, actual exposures of the vast majority of workers are far below the current regulatory limit, and analysis of National Dose Registry records shows that if ICRP's proposed limit were in place today, only 0.6% of workers would exceed it.

Greenpeace: *As a result (of radiation exposures in mines between 1985 and 1987,) more than 270 uranium miners have already died from lung cancer due to radon exposures in northern Ontario alone as of 1986, and the number of cancer deaths are increasing ...*

AECB: False association. An increase in lung cancer incidence among uranium miners resulted from working under non-existent or very liberal radon exposure standards prior to about 15 years ago, not in the last five.

Public

Greenpeace: *According to a study by an independent radiation biologist commissioned by Greenpeace, there is good statistical evidence of a strong association between radioactive tritium emissions into Lake Ontario at the Pickering nuclear power plant and newborn death rates at Pickering between 1980 and 1985. There is also a similar strong association between these emissions and the incidence of certain birth defects, including cleft palate and lip at Pickering.*

AECB: Deceitful. Greenpeace commissioned a review of someone else's study. The review basically said that there were some statistical associations that should be looked into further, but warned that there were reasons to interpret the original study with caution. For instance, the reviewer noted that there were 19 Ontario communities in which the rate of the fatal birth defects in question was higher than in Pickering.

Greenpeace: *... a report from the Charbonneau Commission on toxic wastes ... found extraordinarily high levels of birth defects surrounding the Gentilly nuclear reactor in Quebec, near Trois Rivieres.*

AECB: Dishonest. There is no evidence to connect the Gentilly reactor with the birth defects found in the course of an enquiry on toxic wastes in a heavily industrialized area. If nothing else, the fact that certain defects occurred in one community in neighbouring houses on the same street suggests that there must be some other cause.

Greenpeace: *... the AECB published a study showing statistical evidence of higher than expected incidences of childhood leukemia cases and deaths near nuclear facilities, similar to the excess leukemias in England near the Sellafield nuclear plant which triggered the Gardner study.*

AECB: A deliberate misinterpretation. The main finding of the study in question was that in the vicinity of five Canadian nuclear facilities there was no increase in either incidence of or deaths from this disease similar to that found near the British nuclear fuel reprocessing plant at Sellafield.

Greenpeace: *Greenpeace is presently reanalyzing the AECB data in an attempt to disentangle the AECB's distorted presentation of the findings.*

AECB: Senseless. The childhood leukemia study was conducted under contract by the Ontario Cancer Treatment and Research Foundation. The findings were presented at a news conference by the principal researchers, not the AECB. No "AECB data" was involved.

5. The AECB's Radiation Standards – a Public Disgrace?

Greenpeace: *In 1980, the British Columbia Medical Association stated that the AECB was unfit to regulate and that its radiation exposure standards were "tantamount to allowing an industrially-induced epidemic of cancer."*

AECB: A specious argument. In 1980, two B.C. doctors incensed by a proposal to mine uranium in the province made a seriously flawed submission to the public enquiry looking into the issue. The unfounded statement about a cancer epidemic is just one of many absurdities in the document that led the two to conclude that the AECB was unfit to regulate. The British Columbia Medical Association itself has never counseled the AECB to improve its regulatory practices.

Greenpeace: *Even with the three new 1990 studies, the AECB is still stonewalling and refusing to carry out its health duties properly.*

AECB: Not true. Greenpeace is entitled to its opinion, but it is not based on what the AECB is doing, which includes the introduction of modified dose limits to reflect the new ICRP recommendations, and the continued conduct of appropriate research on health effects associated with nuclear facilities.

Greenpeace: *Revealingly, the AECB, unlike the US EPA (Environmental Protection Agency), has not seen fit to impose any public limit at all on the radioactive radon emitted from uranium mines, mills and mill tailings.*

AECB: False. The Atomic Energy Control Regulations have specified such a limit since 1978.

Greenpeace: *There is no safe level of radiation: all exposures, no matter how small, involve some detriment.*

AECB: Unproven. Greenpeace has presented as fact a very conservative assumption used in radiation protection work. This assumption does not take into account the obvious survival of humans and other species in the earth's naturally radioactive environment, nor the lack of evidence of any detriment even in areas where the background radiation is abnormally high.

Greenpeace: *Reducing the legal limits involves heavy safety costs and the AECB establishes a trade off between these costs and the effects on public health.*

AECB: Wrong. Radiation dose limits are based on the consideration of acceptable levels of risk. The optimization process, which is one of three principles of dose limitation, results in doses being kept as low as reasonably achievable and can involve a cost-benefit consideration. But this process is not used to decide on limits.

Greenpeace: *The result is that the AECB's limits do not represent current scientific thinking but what the Government thinks it can get away with, given the lack of public information about the real dangers of radiation.*

AECB: Absurd. There is plenty of information available to the public on radiation and its hazards, and the news media, unions, professional associations and others would not allow the government to "get away with" inadequate radiation protection standards. The International Commission on Radiological Protection has emphasized for years that legal limits are less important than the actual doses received, and Canada's regulatory approach to keeping actual doses very low is well in line with the system of radiation protection accepted world-wide.

6. Conclusions

(Like the Executive Summary, the Conclusions section of the Greenpeace document is little more than an anti-nuclear diatribe. In seven paragraphs there is only one reference to the question of standards, which is the matter under discussion. But a comment on nuclear weapons warrants a response.)

Greenpeace: *Canada's exports of uranium, reactors, heavy water, and tritium all contribute to nuclear proliferation around the world.*

AECB: Outrageous. Canada adheres to one of the most stringent anti-proliferation policies in the world, and is a leading supporter of the International Atomic Energy Agency (IAEA) with its system of safeguards that uses state of the art accounting procedures, high-tech monitoring equipment and physical inspections to ensure Canadian nuclear materials are only used for peaceful purposes. A United Nations-chartered organization, the IAEA reports to the world each year that Canada's non-proliferation objectives are being achieved.

Annex - Canada's Radiation Limits

Public

Greenpeace: *In 1985, the ICRP recommended that the public limit be tightened to an average of 1 mSv per year but the AECB refused to do this.*

AECB: Misleading. The AECB assessed this recommendation and decided it was not necessary for protection of the public since the actual exposures under the existing limit and licence conditions were already so small (much less than 1 mSv).

Workers

Greenpeace: *(The current worker limit of 50 mSv) is the old level set by the ICRP in 1956 and is viewed by most experts to be obsolete.*

AECB: Questionable. The latest ICRP recommendations retain the 50 mSv limit, with additional provisos, suggesting that it is not exactly obsolete.

Tritium

Greenpeace: *Tritium limits in Canada are the highest in the world.*

AECB: Not honest. Most countries, including Canada, do not have tritium emission limits written in law, and many countries have no limit at all – they don't need them. However, because the Canadian CANDU reactor system is a tritium "producer" due to its design, a limit for tritium emissions had to be established for each power plant, in the interests of public protection. Using conservative or pessimistic assumptions on the possible pathways by which tritium could reach the public (drinking water, food, inhalation, etc.), the emission limit for a facility is set so that the public dose limit will not be exceeded for a hypothetical person living right on the plant boundary. In practice, the plants do not operate anywhere near their emission limit (typically around 1 per cent of it), so whether Canadian limits are "the highest" or not is really irrelevant. (Note: Greenpeace compares Canada's limit to a very much lower one in the U.K. Investigation has revealed that the U.K. figure is an administrative one related to the total inventory of tritium at one particular facility, a very small quantity, and has no relationship to public dose limits at all.)

Greenpeace: *Tritium is very radioactive: one gram of pure tritium contains 360 Terabequerels (9,700 curies) of radioactivity.*

AECB: Deceiving. "Gram for gram" comparisons do not tell the whole story about radioactivity. For example, an amount of pure technetium 99m, a radioisotope injected every day into thousands of hospital patients, contains 500 times as much radioactivity as an equal quantity of pure tritium.

Greenpeace: *... Ontario Hydro (is allowed) to dump vast amounts of tritium into the Great Lakes. In 1988, Hydro pumped 1,570 terabecquerels (45,000 curies) of tritium into Lake Ontario from the Pickering plant alone. This is a huge amount of radioactivity: 20 curies of tritium ingested by a person would be a fatal dose.*

AECB: Inflammatory. In addressing the possible health effects of the Pickering station, one of Greenpeace's own advisors said, "I think it is totally meaningless to express the discharges in terms of lethal dose equivalents." It is quite impossible for anyone to acquire a fatal dose from tritium by drinking lake water. "Quite impossible" is almost an understatement – at the August 1988 concentration of tritium in the lake near the Pickering outlet, you would have to imbibe four billion litres of water to do this.

AECB Post Script

Greenpeace's agitation about the adequacy of Canadian standards undoubtedly arises from the mistaken assumption that radiation dose limits are much like speed limits – everyone operates at or near them, so any reduction would provide better protection for people. But a dose limit is only analogous to a speed limit in one area: it is illegal to exceed it on purpose.

In fact, the radiation protection system applied in Canada through licence conditions, backed up by compliance inspections, ensures that actual doses received from licensed activities by the public and workers range from zero to some fraction of the legal limit – nobody operates at or even close to the limit all the time. Hence a reduction in the numerical limit is not an absolute and urgent requirement to provide improved protection in the majority of cases.

Despite the regulatory pressures and other forces that keep actual doses low, legal dose limits are a necessity. To make the protection of the nuclear regulatory regime legally enforceable, there have to be precisely specified limits which a court may use in evaluating an alleged breach of the law.

Furthermore, in those few occupations in the nuclear field where doses can vary widely with routine circumstances, a legal dose limit is needed to define the upper bound of permissible exposure. This forces the adoption of workplace operating policies and procedures that ensure that if the limit is ever approached or exceeded, it would likely be the consequence of an accident of some sort, and not the result of acceptable practice.

Under the conservative radiation protection principle that any dose has an associated health risk, a dose limit does not define a "safe" level of exposure. However, it should reflect the medical and scientific consensus on the level required to provide a reasonable degree of protection.

This is why the AECB keeps tabs on international studies of the effects of ionizing radiation, evaluates the recommendations of professional bodies concerning radiation protection, and conducts its own health effects research. As new information comes to light, changes in the numerical value of dose limits may be made in the regulations governing nuclear activities.

Under the government's system for making and amending regulations, which includes opportunities for public consultation, it takes time to implement such modifications. Since the radiation protection system keeps most doses as low as reasonably achievable, speed is not a factor in ensuring that no undue risk exists in the meantime.

Comment on Cover Bar Chart

In the Greenpeace document, a cover bar chart entitled "Public Radiation Limits" showed Canada's 5 millisieverts per year (mSv/yr) legal limit against four other values, all smaller: (1) International Commission on Radiological Protection (ICRP) 1 mSv/yr; (2) U.K. 0.5 mSv/yr; (3) Federal Republic of Germany (FRG) 0.33 mSv/yr; and (4) U.S. 0.25 mSv/yr.

This is a deliberately biased comparison because:

(1) the ICRP value is a recommendation, not a national limit;

(2) the U.K. number is a recommendation – the legal limit remains the same as Canada's;

(3) the limit quoted for the FRG applies to each site and therefore should more correctly be compared to Canada's operating target of 0.05 mSv/yr for a nuclear power plant; and

(4) the U.S. value was set by the Environmental Protection Agency on the basis of what was achievable by reactors, not on the basis of risk. Again, the power plant operating target of 0.05 mSv/yr would make a more legitimate comparison.

As the bar chart on the cover of the document you are reading indicates, Canada is not delinquent amongst developed countries when legal limits are compared. What the chart doesn't show is that Canada's radiation protection regime, measured by *actual* doses received by workers and the public, is second to none.